National Aeronautics and
Space Administration

NASA EXPLORES THE UNIVERSE

Simulating Rocky Exoplanet Atmospheres with General Circulation Models

Since 1992 and the discovery of the first exoplanet—a planet orbiting a star other than our Sun—thousands of other exoplanets have been detected. Characterization is the next step, and scientists have analyzed the atmospheres of giant, hot exoplanets with current telescopes. However, Earth-like exoplanets are much smaller and fainter and require the next generation of telescopes to analyze their atmospheres for signs of habitability and life. To prepare these future observations, global circulation models allow simulating synthetic atmospheres on these worlds and their potential for habitability. Among the exoplanets under study are Proxima Centauri b, the closest exoplanet to Earth, and the seven-planet TRAPPIST-1 system.

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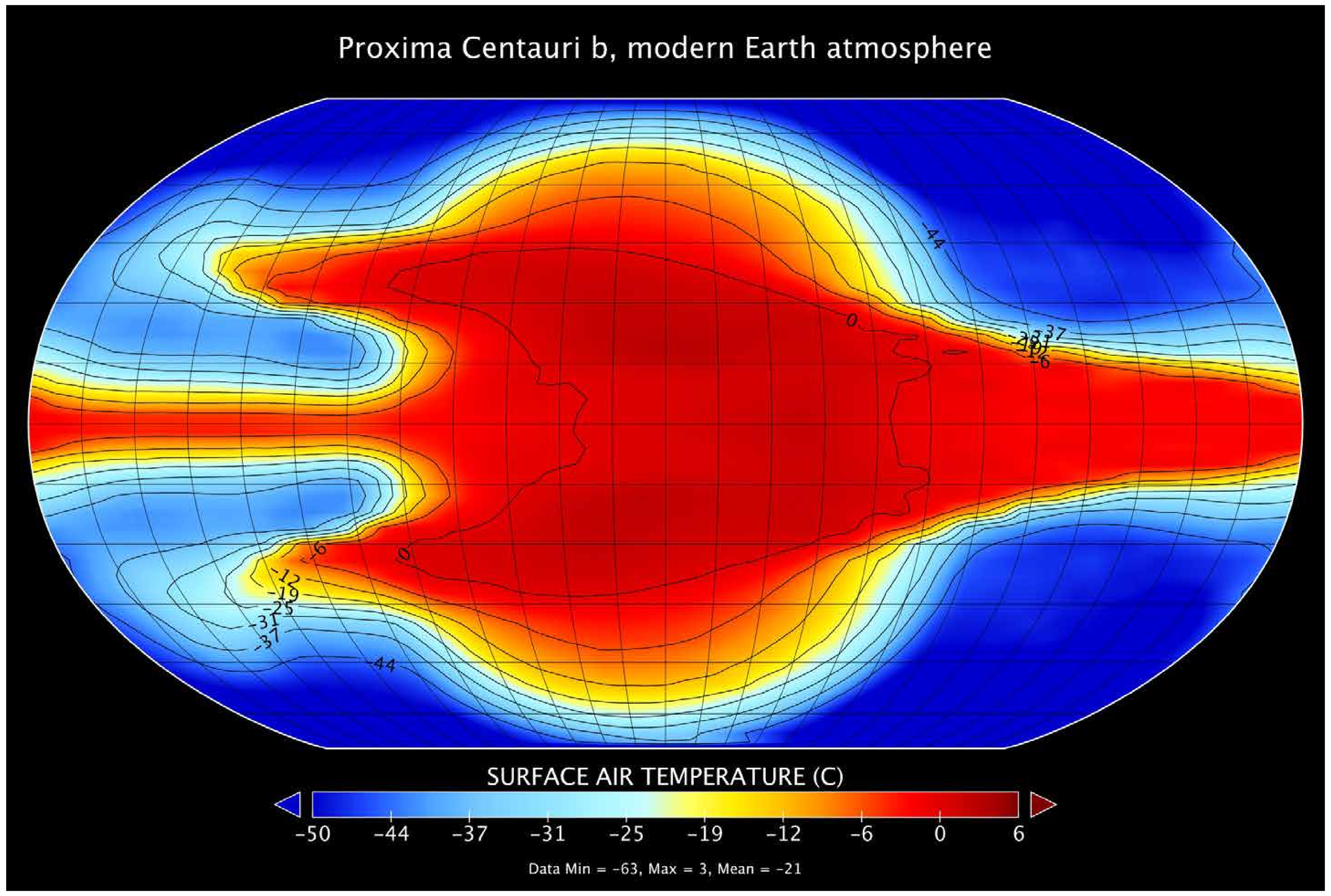
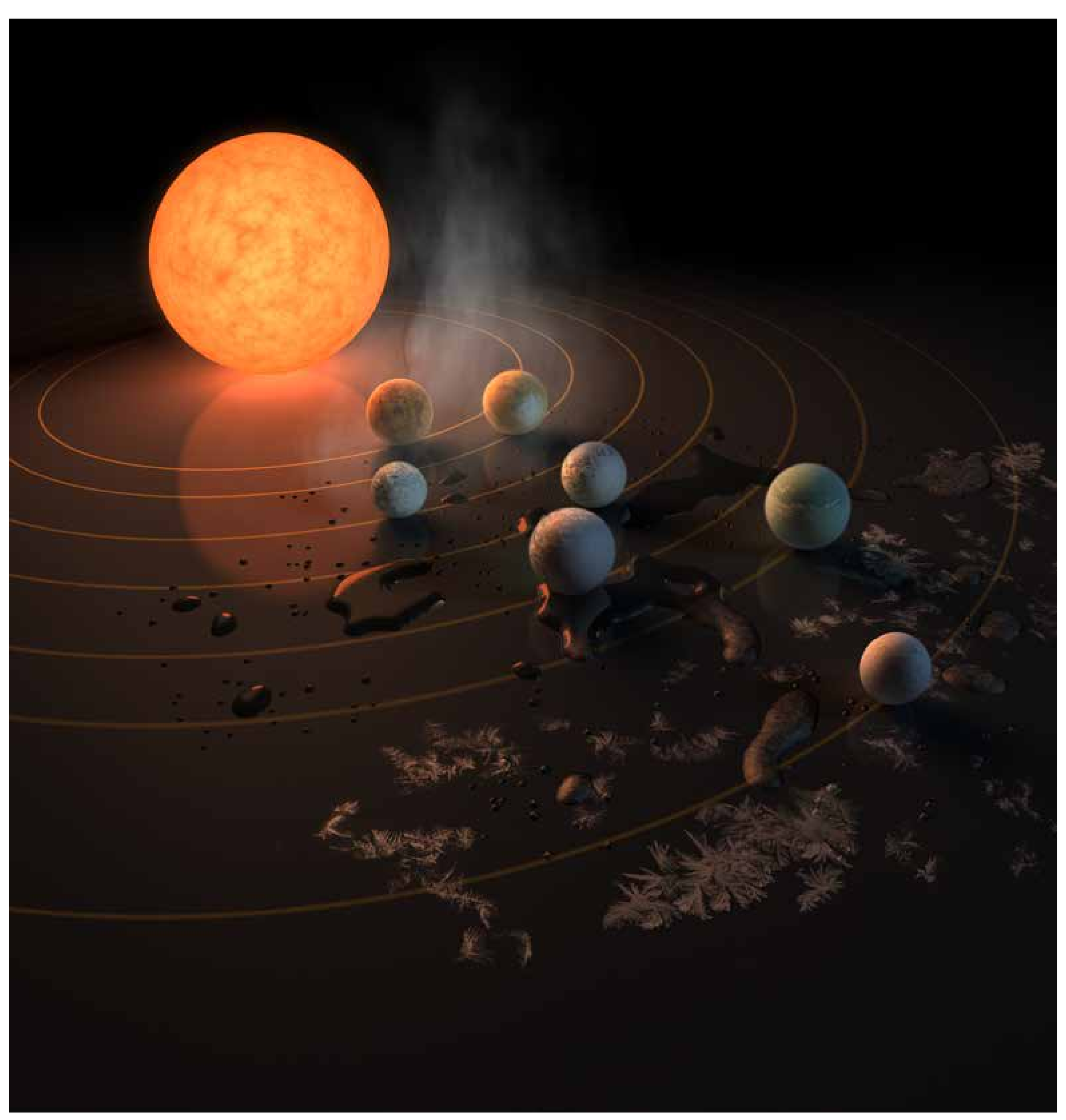


Surface temperature for the Proxima Centauri b exoplanet, assumed to be fully covered by an ocean with a modern Earth-like atmosphere, as simulated with the ROCKE3D global circulation model developed at the NASA Goddard Institute for Space Studies. The plot is centered at the substellar point, the point on the planet's surface at which the star is at zenith. Temperature is above freezing near the substellar point, leading to liquid water and therefore habitable conditions at the surface. *Anthony D. Del Genio, Michael J. Way, NASA Goddard Institute for Space Studies*



An artist's concept of the TRAPPIST-1 star, an ultra-cool dwarf, and the seven Earth-size planets orbiting it. This exoplanet system has been revealed through observations from NASA's Spitzer Space Telescope and the ground-based TRAnsiting Planets and PlanetesImals Small Telescope (TRAPPIST), as well as other ground-based observatories. Three of these planets are in the habitable zone of their star, where liquid water can be potentially present on their surface. *NASA/JPL-Caltech*